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Product labelling and quality standard. I and II

Ove Pedersen

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FISH SILAGE AND QUALITY,

PRODUCT LABELLING AND QUALITY STANDARD I

Silage from fish and fish products will beat all other feed raw materials!

Feed consultant Ove Pedersen

Feitsildfiskernes Salgslag.

(Fat Herring Fishermen's Sales Association)

NORSK FISKEOPPDRETT NR. 2-87, pp. 74-76

This is how silage from fish and fish products was introduced by some people a few years ago. It did not happen. Why not? Those who made this statement did it on good grounds. Well, the answer is the same as it often is when things don't work out:

QUALITY, or more correctly, VARYING QUALITY, and little effort devoted to further developing the product.

This article looks at the need for product labelling and the possibilities and problems involved in improving and assuring the quality of fish silage.

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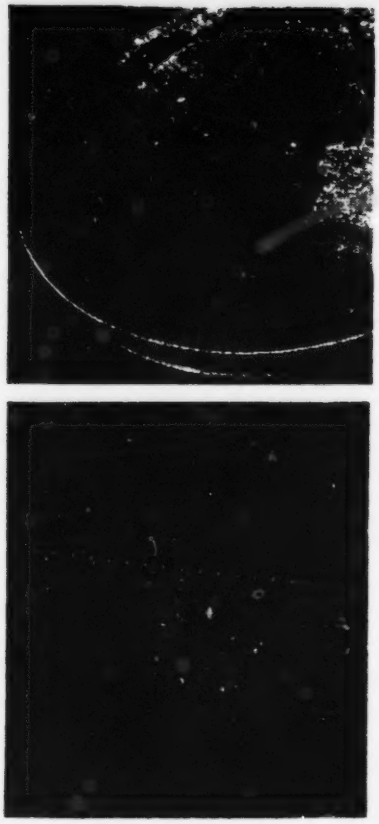
Figure 1.



Silage can be used to make pellets
of a fine cut and good consistency.

Ensilaging is a method of preservation similar to drying, freezing or canning - a method for storing food products or feed raw material over a longer period of time without their becoming spoiled or dangerous to use. Ensilaging is no renewal or rejuvenation process, which, unfortunately, many seem to have believed, judging by the quality of the raw material which has been ensilaged in some cases. When we preserve bad frankfurters, the ensuing result is a poor dinner; in the same manner we also get poor feed when we ensilage inferior raw material.

Already in 1943, encouraging results were obtained from

the first experiments carried out in Norway regarding ensilaging fish products (carried out by the State Experimental Farm for Fur Animals, Heggedal). The advantages of using ensilaging as a preservation method have not decreased with the years. On the contrary, silage from fish and fish products continues to be simple and reasonable to produce, store and handle. Based on these criteria, with reservations concerning certain limitations on usability, ensilaging as a method of preservation of feed raw material is often superior to freezing and drying.

In other words, ensilaging is not a new method of preservation. However, neither freezing nor drying (meal production) were new decades ago when they became the main methods of preserving feed raw material. It is not unlikely that in the future ensilaging may become the main method of preservation for considerable amounts of fish raw material. This will depend on a number of normal competitive factors, of which two will be mentioned, in particular. Firstly, that producers and users learn to utilize the advantages of this method of preservation so that silage from fish and fish products, across the board, results in the same good and stable product as has long been shown possible in experiments. Secondly, that **continuous further development**, both of methods and products, is carried out at a rate that corresponds to other competitive methods and products. How many believed, thirty years ago, that ensilaging would exceed drying as a preservation method of grass for ruminants?

Basis for good quality

Whether a method of preservation of raw material becomes a success or not depends, among other things, on:

1. the quality of the raw material to be preserved;
2. the quality of the preserved feed raw material which reaches the user;
3. the quality of the finished feed, where the actual preserved feed raw material is included as one of several raw materials;
4. the quality of the product (the animal/fish) being produced using the feed raw material in question;

If points 1, 2 or 3 do not meet the requirements, a preservation method will never be given a real opportunity of demonstrating point 4.

The Group has sufficient knowledge and data from analyses to feel that there is a basis for stating that the quality in points 1, 2 and 3 has, unfortunately, been quite varied. Inherent in this is also the feeling that the Group considers that fish silage has not had a proper opportunity to demonstrate how effective it can be in practice as feed raw material.

Product labelling

Based on the foregoing, the Group considers it essential that all deliveries of silage from fish and fish products always be accompanied by a product label. Therefore, the Group has prepared

a proposal for a product label, as shown in Figure 3, "Product Labelling", which is available upon request from the Fish Farmers Sales Association (Fiskeoppdrettternes Salgslag).

There is still no law requiring the use of such product labelling. However, the pressure is on from many sides and it may only be a matter of time before the use of product labelling for silage from fish and fish products becomes law (under the authority of, among others, "Law concerning Inspection of Feed Products").

75.

Product labelling must contain information of significant value to the user. It is therefore recommended that buyers be sceptical of deliveries not accompanied by product labelling. To be told it is fish silage is just as imprecise as being told that a can contains some kind of meat. Who would purchase canned meat without being told the type of meat preserved; whether it is sirloin filet , monkey brain, snake meat, or ox tails?

Sampling

Sampling is the alpha and omega of analysis. The sample must be representative, i.e., it must represent an average of the lot it was taken from. Unless a sample is representative, all the best analyses in the world are of little or no value and may even be directly misleading.

In fish silage it is necessary to be particularly aware of phase separation (fat floats to the top and undissolved bones and the like sink to the bottom). Appropriate

and good stirring of the fish silage is therefore important. Fat which has separated is difficult to get properly back in the fish silage again.

Methods of analysis

A parameter such as, for instance, percentage of fat, can be analysed by several methods. There are also alternative methods of analyzing the same parameter. In the selection of method of analysis, factors such as laboratory equipment, capacity, competence, tradition and requirements for profitability and reliability, will be weighed against the customer's demand regarding price, speed and specific and relative accuracy. The selection of method becomes particularly problematic because the **various methods of analyses produce, to a greater or lesser degree, somewhat varying values for the same parameters.** In a recent test between various laboratories, the percentage of fat varied from 17 to 20%, due to, among other things, different methods of analysis. When determining the anisidine figure (a measure of fat rancidity), the differences in the same sample, between the laboratories, were so great that the Group could not defend the use of this parameter in a quality standard unless all the laboratories agreed to use the same method of analysis. In order to obtain the best possible comparable figures and not to have to deal with differences, it would be best if all laboratories used the same methods and equipment. But because of, among other things, the above-mentioned conditions, and because it is a matter of prestige for some laboratories that it is their methods that are the

(continued on p. 10)

Figure 2.

"Quality Standards Group for Fish Silage"

On 5 December 1985, Feitsildfiskernes Salgslag (FFS) (Fat Herring Fishermen's Sales Association) arranged a meeting between various groups of producers and buyers of silage from fish and fish products.

At that meeting it was pointed out that since the product after ensilaging is "unidentifiable" and very difficult to quality-evaluate based on look, smell and taste, there is a great need for concrete quality standards. This is primarily to protect the users, but also in order to in the long term ensure that silage from fish and fish products can establish itself and remain as a safe and good feed raw material for fish, fur animals and traditional domestic animals.

The participants at the meeting therefore resolved to cooperate in taking the initiative to form a group with the task of preparing a quality standard for silage from fish and fish products. The undersigned, feed consultant in FFS, was asked to ensure that such a "Quality Standards Group For Fish Silage" be formed. With the approval of all parties concerned, the following members were selected to be in the group:

Gudbrand Loftsgaard - Pelsdyrnæringens Laboratorium (Fur Animal Nutrition Laboratory)

Haakon Myklestad	-	Fiskeridirektorates Sentrallaboratorium, Kontrollverket (The Directorate of Fisheries Central Laboratory (Inspection Board))
Leif Rein Njaa	-	Fiskeridirektoratets Ernæringsinstitutt (Institute of Nutrition, Directorate of Fisheries)
Magnar Pedersen	-	Norges Råfisklag (Norwegian Raw Fish Association)
Ove Pedersen*	-	Feitsildfiskernes Salgslag (Fat Herring Fishermen's Sales Association)
Roger Stefanussen	-	Fiskeoppdretternes Salgslag (Fish Farmers' Sales Association)
Bjarne Stormo	-	Rieber & Co.
Torbjørn Åsgard	-	AKVAFORSK. (NLVFs Institutt for akvakulturforskning) (Institute for Aquaculture Research)

* Group Coordinator

The following is a summary of the Group's work up to now. The main goal of the Group is make sure that any silage from fish and fish products which arrives on the market is stable and of the highest possible quality.

Figure 3

Proposed product labelling for silage from fish and fish products.

PRODUCT LABELLING
FOR
SILAGE
FROM
FISH AND FISH PRODUCTS

PRODUCED BY:

Fish	Raw Material	% mix.	Int.ref. no.

Period of production from (incl.) date:..... to (incl.)date: 19

Additives: Name of product:

Type of Acid %	kg. per tonne
%	kg per tonne
Anti-oxidant %	gramme per tonne

Declared content: g/100g (%)		Additional information: Parameter:		
Protein	_____	TVN	% _____	% of tot.N
Fat	_____	TMA-N	% _____	% of tot.N
Ash	_____	TMAO-N	% _____	% of tot.N
Dry matter	_____	Peroxide	% _____	m equiv/kg f
		Tot. no. live bact.	% _____	per gramme
pH	_____	Tot. no. fungi/mold	% _____	per gramme

Lab. analysis enclosed Yes No Name of Lab. _____

Other information: _____

pH at time of delivery:_____ Date: _____ SIGN.: _____

PRODUCER:

_____

(continued from p. 6)

best, it has been found impossible to reach that goal. The Group has, however, not given up and will continue to attempt to arrive at uniform methods or at least one reference method for each individual parameter. 76.

pH

pH is a measure of the degree of acidity. The pH scale goes from 1 (very acidic) to 14 (very basic/alkaline), with pH 7 as the neutral point. The scale is logarithmic, so that, for instance, pH 4 is 10 times "more acidic" than pH 5. Ideal pH will depend on area of use and what acids are used. If formic acid only is used, a pH of between 4.0 and 4.3 is recommended. Should the pH be 4.5 or more, it may easily result in too great microbial activity, decay and a product dangerous to health. The pH value is not stable and should therefore be checked at regular intervals, particularly when the fish silage is fresh, the temperature is high and the ash and bone contents are high. Silage of fish and fish products has a certain buffer capacity. This means, among other things, that a relatively large amount of formic acid can be added without the pH decreasing correspondingly. Therefore, it is also of interest to a user to know how many kg of acid were used per tonne of raw material. When only formic acid is used, the pH should not be below 3.8. The lower the pH, the more storage-stable the silage. The higher the pH, the less acidic the ready feed. A balance must be struck between these.

Ash and dry matter

As is evident from the proposed product labelling, the Group has elected to state content of both ash and dry matter (not fat-free dry matter) in addition to protein and fat. The reason for this is, among other things, that a certain amount of control can be exercised over how well fat and protein analyses are carried out by the laboratories. This is possible because fat + protein + carbohydrates + ash are approximately equal to dry matter. Content of carbohydrates in fish is rather low, so that the value of carbohydrates can, in this context, be given as zero. In other words, silage from fish approximates: % protein + % fat + % ash = % dry matter. It is easy to analyse ash and dry matter content. Should there be too great a deviation in the sum of protein + fat + ash in relation to the dry matter content (not fat-free dry matter), then there is reason to suspect errors, either with the protein or the fat analysis, and most often the latter.

The content of ash can also indicate whether the silage is produced from, for instance, guts only, or has too high bone content. The more pure fish meat or guts, the lower the ash content, and the more bone, the higher the ash content. The ash content is normally about 2 or 3 g per 100 g round fish (that is, 2 - 3 %). The ash content will also, to a certain degree, indicate what the fish silage is produced from.

Consistency - Viscosity

Some users believe that thick-flowing fish silage contains more nutrients than thin silage. How thick the fish silage is depends mainly on the temperature at which the fish silage is produced and stored. The higher the temperature, the thinner the silage is. Thus, a thin fish silage may contain more nutrients than a thick one. It is often more important to the user that the fish silage be properly stirred and has not separated.

Part II published in No. 3 - 87.

Advertisement on p. 76 of the original text.

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NODEC A/S c/o Håvard Bakken, Prof. Brocks gt. 7, 7000 Trondheim, 07 54 54 01*

SIEMENS A/S, c/o Trygve Ulfsnes, Brambergvn. 5, 7000 Trondheim, 07 96 55 11*

*Street names and numbers, as well as telephone numbers may be slightly incorrect, as the very fine print was almost impossible to read. TR.

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Fish Silage and Quality, Product Labelling and Quality Standard II.

NORSK FISKEOPPDRETT Nr. 3-87, pp. 50-51.

By Ove Pedersen, Feitsildfiskernes Salgslag, Trondheim.

Quality standard

The concept quality is often attributed sharply diverse contents. In a commercial context, the concept quality is often limited, with regard to fish silage, to its pH and content of protein, fat, dry matter and ash. In this connection, the concept is used in a relaxed manner, as there is no known single analysis which can produce all the information desired concerning the quality of a particular fish silage. Many different parameters have been evaluated and also tried to various degrees in different countries. Some of these are:

TVN (Total volatile nitrogen)

TMA-O (trimethylamine-oxide)

TMA (trimethylamine)

Biogenic amines

FFA (Free fatty acids)

PO (Peroxide number)

Anisidine number

Total oxides

Antioxidant remnants

Thiaminase activity

Total counts of live bacteria
Various specific indicator bacteria.
Number of mould and yeast fungi.

Which parameters ought to be included in a quality standard depends on, among other things, how reliable they are, what they actually tell, the time it takes to carry out the analysis, how many (and which) laboratories can carry them out and how important they are in a commercial context. Furthermore, the total cost of analyses must not be so high that, in practice, they are omitted.

Based on, among other things, these criteria, the Group has arrived at the following **proposal** for a quality standard for silage from fish and fish products:

1. Total volatile nitrogen (TVN)
2. Trimethylamine nitrogen (TMA-N)
3. Trimethylamine-oxide (TMAO-N)
4. Peroxide number
5. Total number of live bacteria less than 100,000 per gramme.
6. Total number of fungi/mould less than 5,000 per gramme.

The reason a numerical limit value has not been established for other than the two microbiological parameters is that the Group prefers to wait until it has more reliable data to base it on.

The Group wants to emphasize that it is difficult to formulate a complete and fully reliable quality standard for fish

silage. Granted, at some laboratories considerable analytical material can be found. Unfortunately the information available on individual analyzed samples is often very deficient. This makes it difficult to draw any firm conclusions.

The group does not consider its work on a quality standard concluded and will continue to try to have experiments carried out to obtain more of the desired information. In this connection, it should be mentioned that biogenic amines (histamine, cadaverine and putrescine) look promising as useful parameters in a quality standard.

Volatile nitrogen compounds.

Total volatile nitrogen (tot. vol. N or TVN) is, in practice, usually considered to be the sum of ammonia nitrogen (NH3-N) and trimethylamine nitrogen (TMA-N). Ordinarily, analysis is carried out only for TVN and either TMA-N or NH3-N, since the other shows up as the difference.

The group suggests expressing TVN as a percentage of total nitrogen. TVN expressed as mg N per 100 gr sample does not show how much of the total amount of nitrogen is volatile. TVN expressed as a percentage of total amount of nitrogen provides direct comparable values independent of the percentage of protein in the sample. In some countries, this method of expression is in use in connection with fish silage. The conversion between the two methods of expression can be carried out using the following formulas:

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$$\% \text{ of tot. N} = \frac{\text{mg per 100g sample} \times 6.25}{10 \times \text{protein \%}}$$

$$\text{mg per 100g sample} = \frac{\% \text{ of tot. N} \times 10 \times \text{protein \%}}{6.25}$$

The volatile nitrogen compounds are formed mainly from two sources. Ammonia (NH_3) is formed from the protein; the trimethylamine (TMA) - and lesser amounts of dimethylamine (DMA) - are formed from trimethylamine oxide (TMAO). Since ammonia is only formed by protein, it is only the ammonia in TVN that could possibly be used as a direct measure of the quality of protein. Ammonia is formed by three different processes:

1. Bacterial activity
2. Enzymatically
3. Purely chemically.

In fresh raw material all these processes occur; mostly the bacterial process and least of all the chemical process. Ensilaging inactivates or destroys the bacteria but does not, however, stop the other two processes. On the contrary, ensilaging provides the other two processes with better conditions. Much of the fish's own natural enzymes (such as digestive enzymes) function excellently even after ensilaging and will continue to form ammonia from the protein. This process is dependent on, among other things, storage temperature, and its

rate will decrease with time. It is the activity from the fish's own enzymes (and not the acid) that is responsible for the "fine-grinding" (autolysis) of the raw material and that gives the mass its relatively fluid consistency.

The enzymes split some of the protein into its individual components/building blocks which are called amino acids. Some of the freed amino acids (glutamine and asparagine*) will be able to chemically liberate NH_3. It is not known whether such liberation has any effect on the protein quality. Even in properly treated fish silage, the amount of NH_3 will increase with time.

Trimethylamine (TMA) is the degradation product of trimethylamine oxide (TMAO). For simplicity's sake, only the nitrogen from these compounds is analyzed, that is, the TMA-N and TMAO-N. The amount of TMAO-N in fish varies from about 1 to about 4% of total N, depending on, among other things, the type of fish and time of year. It has been found that the value of TMA changes little after ensilaging. TMA is formed mainly by bacterial degradation of TMAO. When the acid is added, the bacteria are inactivated or destroyed, and the TMS level is therefore kept fairly stable. The content of TMA-N indicates, therefore, how fresh the fish raw material was at time of ensilaging. However, due to the TMAO-N content's strong variation with type of fish and time of year, it is necessary to look at the content of TMA-N in relation to TMAO-N. The percentage of

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* Text reads: asplaragin. TR.

TMA-N from TMAO-N + TMA-N will therefore provide a good measure of bacterial activity in the raw material (degree of freshness) **prior** to preservation. The lower the percentage of TMA-N from TMAO-N + TMA-N, the fresher the raw material was when it was ensilaged.

In other words, TVN measured in fish silage is not an unambiguous measure of either the quality of protein or the degree of freshness of the fish raw material at time of ensilaging. TVN must, therefore, be evaluated in relation to both the age and storage conditions of the fish silage and the respective contributions from ammonia and trimethylamine.

So far, the Group has not been able to establish a well-based limit value for TVN in fish silage. Various countries and fields of application operate with limit values for fish silage which vary from 2.5% to 4% TVN of total nitrogen. Special notice should be taken that silage of cartilaginous fish / sharks, such as for example spiny dogfish, will always show a high content of TVN; up to 20-30% of the nitrogen may be urea-N.

Peroxide number.

The peroxide number is a parameter which indicates how oxidized (rancid) the fat is. The amount of peroxide increases sharply when rancidification begins but will later decrease again. The values obtained also depend on how fast the peroxides convert to aldehydes. The Group did not even wish to set limit values for this parameter. The reason is partly that there is little data clearly indicating that the harmful effects are related to

given limit values for this parameter. Furthermore, the roup preferred to wait for the results of studies involving quality determination of fat. The lowest possible values are, of course, preferable. **Fish silage should not be produced without the addition of antioxidants during production.** The normal is 200 ppm (gramme per tonne) ethoxyquin, but should be adjusted to the fat content and estimated storage time so that there is certain residual antioxidant left at time of usage.

For the sake of order it should be mentioned that peroxide values are given two different ways, as milli-equivalents or as milli-mol per kg fat. 1 millimol O_2 = 2 milli-equivalents O_2. The Group recommends that the peroxide number be given as milli-equivalents (meq) per kg fat.

Final Comments

Many readers may still be left with a negative feeling towards fish silage and its producers. It is, therefore, only proper to emphasize that there are many serious producers of fish silage. Furthermore, there are also many users who have had very good results using silage from fish and fish products as feed raw material.

It is also right and proper to point out that the varying quality of silage from fish and fish products is not totally to blame for the varying results sometimes found. Insufficient knowledge concerning **treatment** of fish silage (such as stirring) and **feed composition**, particularly with regard to balancing the energy of the feed, is one of the main causes of

varying results with self-produced feeds. In addition, the quality and functionality of the other feed raw materials mixed with the fish silage are of deciding significance to the final result.

The future use of product labelling would be a good indicator of who are serious producers and users of silage from fish and fish products.

The Group would like to repeat that it should be matter-of-course that all lots of fish silage be delivered accompanied by a product label. It may not be appropriate to fill out the blocks reserved for additional information for each small lot. Here practicality and user requirements should be assessed in each individual case.

Inspection of a product is, at the beginning, not the best method of ensuring quality. Trust between producer and user is a far better guarantee of quality. The best guarantee of quality does, however, appear to be a cultivated trust relationship between producer and user together with a product that is inspected periodically.

Trust in the producer is, however, paramount. The possibilities are many and the potential of fish silage as feed raw material for fish, fur-bearing animals and traditional domestic animals is increasing. The quality of the product and the efforts directed towards research and development will decide when and to what degree this potential will be exploited.

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